Science MATTERS!
... IN CONNECTICUT

NIE ACTIVITY Science Matters! is a series presented in collaboration with the Connecticut Academy of Science and Engineering.
*For more information, visit **www.ctcase.org** or **call 860.571.7143**.*

Making a Safe, Biodegradable Mask for COVID 19

Thanh Duc Nguyen, PhD, Assistant Professor, Department of Mechanical Engineering, Institute of Materials Science, UConn

In 2020, as the Covid-19 pandemic hit the world, me and my research team thought about using nanofibers mats for a kind of special protective mask. I have filed a patent for a biodegradable and **piezoelectric** face mask along with my graduate students including Eli Curry, Thinh Le and Tra Nguyen.

When Covid-19 broke out, Americans rushed to buy and store medical equipment, especially protective masks, which led to a critical mask shortage for medical workers. Many people could not buy protective masks for themselves and their family members. Our team hopes the face mask's invention will address this shortage and could be a huge contribution to the society.

The conventional masks/respirators are not reusable and are usually disposed of after 8-12 hours of use. Most of them are made of synthetic polymer similar to plastic bags. So, disposed medical masks create billions of tons of waste that will take years to decompose in a landfill, which can cause pollution and harm to the environment.

Surgical masks are helpful, but they cannot prevent bacteria, viruses, and fine dust as well as KN95 or N95 masks. Nevertheless, N95 masks are expensive and do not decompose. As such, we decided to use autolytic polymer film to make masks with the filtration capability nearly the same as the N95. However, our masks can be reused after sterilization with simple methods (**autoclave** or ultrasound wave in jewelry cleaners). More importantly, they decompose after several years. The nanofibers film is used in many medical products, but this is the first time it has been used to filter dust, bacteria, and viruses. Thanks to the piezoelectric effect, the nanofibers layers inside the masks can create a small voltage when there is airflow from breathing, sneezing, or coughing. The electrical voltage creates an invisible protective layer, preventing the penetration of charged droplets of water, which bring viruses and bacteria. The nano polymer film allows a filtration capability that is nearly as high as N95 and higher than other surgical masks.

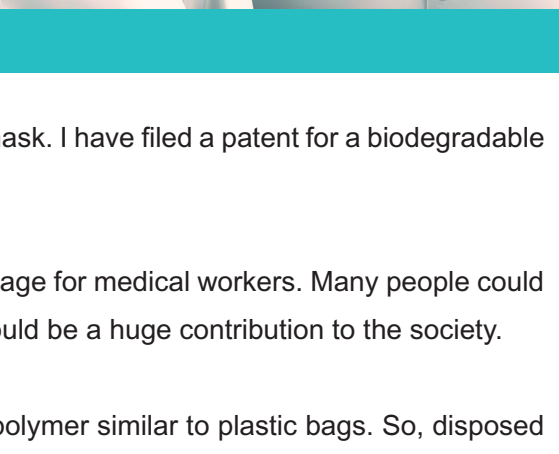
We tested and found that the piezoelectric effect would not be lost after sterilization or disinfection using high temperature, high pressure, or ultrasonic vibrations. Hence, they can be used many times.

Our Lab at UConn is still in the stage of research and product packaging. We are also working to prepare for the establishment of a startup for product commercialization. I hope the masks will be used widely in one or two years.

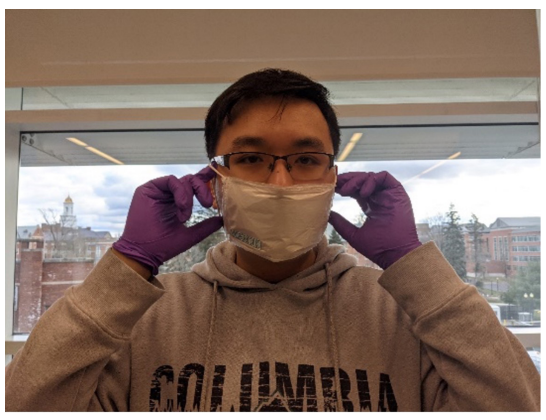
Meet the Scientist

My parents are doctors and two of my sisters are a nurse and a pharmaceutical researcher. I have been familiar with medical terms from my family's dinner talks and understanding deeply how important medicine is for human life. However, I was good at math and physics at high school without much interest in biology and chemistry. Part of it is because I did not understand the subjects the way they were taught in Vietnam. Too much terminology and things to remember without visualization and specific examples for how impactful that knowledge was in the real world. I did not appreciate biology until I went to my PhD school (Princeton University) to work in the field of materials and their applications for biology. I started to learn that there are so many wonderful things in biology that can be applied for human life. The dream of doing research in the field that hybridizes engineering, material science and medicine became real when I was recruited into the lab of Prof. Robert Langer for my postdoctoral training at MIT. There, I met many wonderful researchers in biotech. Especially, I was inspired by my postdoc mentor, Prof. Langer, and wanted to become a leading researcher like him in this field of biomedical engineering. I wanted to work on highly impactful science and research which can be commercialized and translated to real world and applicable to improve human life in terms of medicine.

When I was young, I liked to play a lot of soccer, pretty much everyday and I still play today, just not as much as when I was young. I like sports in general and do exercise daily. I think sports refreshes me and is very effective in helping me to develop logical thoughts and ideas for my work. Besides, I have a small family with two lovely daughters and a wonderful, supportive wife. I enjoy any time our family is together.



Dr. Thanh Nguyen (Assistant Professor of Mechanical Engineering and Biomedical Engineering, UConn)



Thinh Le: Student in Nguyen Lab is wearing a prototype of the biodegradable piezoelectric face mask

Words To Know

Piezoelectric material: is a kind of smart material which generates an electric charge in response to applied mechanical stress and vice versa.

Autoclave: steam sterilizers and are typically used for healthcare or industrial applications.

Skills & Knowledge

This research is highly interdisciplinary at the interface of biomaterials and nano/micro-technology. Hence, a good understanding of physics and chemistry is recommended. In addition, critical thinking, asking good questions, time management, working hard and smart are some soft skills that are necessary to carry out successful research. As an advisor, I always encourage my students and mentee to learn and master those.

hyperlinks https://youtu.be/gqG0BgOT4fk

For Students and Teachers Making Curriculum Connections, see the following:

Connecticut State Department of Education (CSDE) - Common Core State Standards (CCSS): Mathematics

- CCSS.Math.Practice.MP1 Make sense of problems and persevere in solving them
- CCSS.Math.Practice.MP3 Construct viable arguments and critique the reasoning of others
- CCSS.Math.Practice.MP5 Use appropriate tools strategically

CSDE - Next Generation Science Standards: Scientific and Engineering Practices

- Asking questions and defining problems; developing and using models; planning and carrying out investigations; analyzing and interpreting data; using Mathematics and computational thinking; constructing explanations and designing solutions; engaging in argument from evidence; and obtaining, evaluating, and communicating information.

NIE NEWS IN EDUCATION